CLAIMS

1. A method of recording images of a subject object from different positions and orientations and processing the recorded image data to generate a three-dimensional computer model of the subject object, comprising:

supporting the subject object above a calibration object having a predetermined pattern of features using an object support;

recording at different positions and orientations a plurality of images of the subject object supported above the calibration object;

processing the recorded image data to calculate the position and orientation at which each of at least some of the images were recorded; and

performing processing using the calculated positions and orientations to generate data defining a three-dimensional computer model of at least the subject object.

2. A method according to claim 1, wherein the images of the subject object supported above the calibration object are recorded with a background of a substantially uniform colour behind the subject object such that, in each recorded image, the outline of the subject object

is surrounded by the background except where the outline touches the support.

3. A method according to claim 2, wherein the background is provided by a background screen.

4. A method according to claim 2, wherein at least the part of the object support adjacent the subject object is substantially the same colour as the background, and wherein the processing to generate the three-dimensional computer model comprises generating data defining a three-dimensional computer model of the subject object and a separated three-dimensional computer model of the object support.

5. A method according to claim 1, wherein at least the part of the object support adjacent the subject object is substantially transparent, and wherein the processing to generate the three-dimensional computer model comprises generating data defining a three-dimensional computer model of the subject object and a separated three-dimensional computer model of the object support.

6. A method according to claim 1, wherein the subject object is supported by at least one surface of an object

support standing on the calibration object, and wherein each surface of the object support supporting the subject object does not protrude substantially from beneath the subject object.

7. A method according to claim 1, wherein the object support has calibration features thereon, and wherein the processing to calculate the position and orientation at which each of at least some of the images were recorded includes detecting calibration features on the object support in image data and using the positions of the detected features to calculate the positions and orientations at which the images were recorded.

8. A method according to claim 7, wherein data defining the relative positions of the calibration features on the object support is prestored and used to calculate the positions and orientations at which the images were recorded.

9. A method according to claim 7, wherein the object support is arranged relative to the calibration object in a predetermined configuration, and wherein data defining the positions of the calibration features on the object support relative to the positions of the features

on the calibration object is prestored and used to calculate the positions and orientations at which the images were recorded.

10. A method according to claim 1, wherein the subject object is supported above a reflective surface, and wherein processing is carried out to generate texture data for the three-dimensional computer model of the subject object in dependence upon image data that corresponds to reflections in the reflective surface.

11. A method according to claim 1, wherein the calibration object is three-dimensional.

12. A method according to claim 1, wherein the object support and the calibration object are formed as one, with the subject object being supported thereby above the predetermined pattern of features thereon.

13. A method of processing image data defining a plurality of images recorded at different positions and orientations of a subject object supported by an object support above a calibration object having a predetermined pattern of features, comprising:

processing the image data to calculate the positions

and orientations at which at least some of the images were recorded, and

performing processing using the calculated positions and orientations to generate data defining a three-dimensional computer model of the subject object but not the object support.

14. A method according to claim 13, wherein the calculation of the positions and orientations at which at least some of the images were recorded includes detecting matching features in the image data defining respective images corresponding to features on the object support.

15. A method according to claim 13, wherein the generation of the data defining the three-dimensional computer model comprises:

processing images to segment image data relating to at least the subject object from background image data; and

processing the segmented image data and the calculated positions and orientations to generate the data defining the three-dimensional computer model.

16. A method of processing image data to generate a

three-dimensional computer model, comprising:

receiving image data defining at least in part a plurality of images of a subject object supported by an object support recorded at different relative positions and orientations;

receiving data defining the positions and orientations at which the images were recorded; and

processing the received data to generate data defining a three-dimensional computer model of the subject object but not the object support.

17. A method according to claim 13 or claim 16, wherein the generation of data defining the three-dimensional computer model comprises performing processing using at least one known parameter of the object support to generate data defining the three-dimensional computer model of the subject object without generating data defining a three-dimensional computer model of the object support.

18. A method according to claim 17, wherein the known parameter of the object support is the height of the object support.

19. A method according to claim 18, wherein the

generation of data defining the three-dimensional computer model of the subject object includes:

defining a volume of voxels in a three-dimensional space in dependence upon the known height of the object support such that the object support, but not the subject object, is excluded from the volume; and

removing voxels from the volume in dependence upon the image data.

20. A method according to claim 13 or claim 16, wherein the generation of data defining the three-dimensional computer model comprises performing processing to generate at least one three-dimensional computer model of the subject object and object support and performing processing to remove the three-dimensional computer model of the object support.

21. A method according to claim 20, wherein the processing to remove the three-dimensional computer model of the object support is carried out in dependence upon signals input by a user defining the three-dimensional computer model to be removed.

22. A method according to claim 21, wherein the processing to remove the three-dimensional computer model

of the object support comprises:

(a) generating image data for display to a user defining an image of the three-dimensional computer model of the subject object and object support together with a plane moveable by the user;

(b) receiving signals input by the user defining a position of the plane;

(c) repeating steps (a) and (b); and

(d) removing the three-dimensional computer model which lies on a predetermined side of the plane.

23. A method according to claim 22, wherein:

the subject object is supported on the top-most surface of an object support standing on the calibration object;

the plane is generated so as to have an orientation in a substantially horizontal plane; and

processing is performed to allow the user to move the position of the plane but not to change the orientation of the plane.

24. A method according to claim 22, wherein the plane is generated with the same shape and cross-sectional area as the object support.

25. A method according to claim 22, wherein the removal of the three-dimensional computer model which lies on the predetermined side of the plane comprises:

defining a volume of voxels in a three-dimensional space such that a boundary of the volume is at a position corresponding to the position of the plane; and

removing voxels from the volume in dependence upon the image data.

26. A method according to claim 21, wherein processing is carried out to generate a three-dimensional computer model of the subject object and a separate three-dimensional computer model of the object support, and wherein the removal of the three-dimensional computer model of the object support comprises generating image data for display to the user defining at least one image of the three-dimensional computer models, receiving signals input by the user defining one of the three-dimensional computer models and removing one of the three-dimensional computer models in dependence upon the signals input by the user.

27. A method according to claim 20, wherein the processing to remove the three-dimensional computer model of the object support includes processing to identify the

three-dimensional computer model to remove without signals input by a user.

28. A method according to claim 27, wherein processing is carried out to generate a three-dimensional computer model of the subject object and a separate three-dimensional computer model of the object support, and wherein processing is carried out to remove the three-dimensional computer model having a position closest to the position corresponding to the position of the calibration object.

29. A method according to claim 27, wherein processing is carried out to test at least one property of the three-dimensional computer model at different positions and to remove a part of the three-dimensional computer model in dependence upon a position at which the tested property changes.

30. A method according to claim 29, wherein at least one of the cross-sectional area and colour of the three-dimensional computer model is tested.

31. A method according to claim 27, wherein data defining a reference three-dimensional computer model of

the object support is prestored, the reference model is compared against the three-dimensional computer model of the subject object and the object support to identify the part thereof which corresponds to the object support, and the identified part is removed.

32. A method according to claim 13 or claim 16, wherein the generation of the data defining the three-dimensional computer model includes generating texture data using the image data.

33. A method according to claim 32, wherein the generation of the texture data includes processing the image data to identify data corresponding to a reflection of the subject object in a reflective surface, and using the identified data to generate texture data for a surface of the three-dimensional computer model.

34. A method according to claim 16, wherein the received image data comprises image data relating to the subject object and object support previously segmented from other image data in the recorded images.

35. A method according to claim 13 or claim 16, further comprising generating a signal conveying data defining

the three-dimensional computer model of the subject object.

36. A method according to claim 35, further comprising recording the signal either directly or indirectly.

37. A method of processing images of an object to generate data defining a three-dimensional computer model of the object and to amend the three-dimensional computer model, comprising:

(a) receiving image data defining at least in part a plurality of images of an object recorded at different positions and orientations;

(b) receiving data defining the positions and orientations at which the images were recorded;

(c) processing the received data to generate data defining a three-dimensional computer model of the object;

(d) generating data for display to a user defining an image of the three-dimensional computer model together with a plane moveable by the user;

(e) receiving signals input by the user defining a position and orientation of the plane;

(f) repeating steps (d) and (e); and

(g) removing the part of the three-dimensional computer

model which lies on one side of the plane.

38. A method according to claim 37, wherein the processing to remove the part of the three-dimensional computer model which lies on one side of the plane comprises processing received image data and received position and orientation data to generate data defining a three-dimensional computer model of the object in a three-dimensional space having a boundary defined by the plane.

39. A system for recording images of a subject object from different positions and orientations and for processing the recorded image data to generate a three-dimensional computer model of the subject object, comprising:

a calibration object having a predetermined pattern of features;

an object support for supporting the subject object higher than the calibration object;

an imager operable to record, at different positions and orientations, a plurality of images of the subject object supported higher than the calibration object; and

an image data processing apparatus, comprising:

a position and orientation calculator operable to

process the recorded image data to calculate the position and orientation at which each of at least some of the images were recorded; and

a computer model generator operable to perform processing using the calculated positions and orientations to generate data defining a three-dimensional computer model of at least the subject object.

40. A system according to claim 39, further comprising a screen having a substantially uniform colour for placing behind the subject object so that images of the subject object supported higher than the calibration object can be recorded with the screen behind the subject object such that, in each recorded image, the outline of the subject object is surrounded by the background except where the outline touches the support.

41. A system according to claim 40, wherein:

at least the part of the object support adjacent the subject object when the subject object is placed thereon is substantially the same colour as the screen; and

the computer model generator is operable to generate data defining a three-dimensional computer model of the subject object and a separated three-dimensional computer

model of the object support.

42. A system according to claim 39, wherein:

at least the part of the object support adjacent the subject object when the subject object is placed thereon is substantially transparent; and

the computer model generator is operable to generate data defining a three-dimensional computer model of the subject object and a separated three-dimensional computer model of the object support.

43. A system according to claim 39, wherein the object support is arranged such that, when the subject object sits thereon, no surface supporting the subject object protrudes substantially from beneath the subject object.

44. A system according to claim 39, wherein:

the object support has calibration features thereon; and

the position and orientation calculator is operable to detect calibration features on the object support in image data and use the positions of the detected features to calculate the positions and orientations at which the images were recorded.

45. A system according to claim 44, wherein the image data processing apparatus includes a data store for prestoring data defining the relative positions of the calibration features on the object support, and the position and orientation calculation is operable to use prestored data from the data store to calculate the positions and orientations at which the images were recorded.

46. A system according to claim 44, wherein:

the object support is arranged to connect to the calibration object in a predetermined configuration;

the image data processing apparatus includes a data store for prestoring data defining the positions of the calibration features on the object support relative to the positions of the features on the calibration object when the object support is connected to the calibration object; and

the position and orientation calculator is operable to use prestored data from the data store to calculate the positions and orientations at which the images were recorded.

47. A system according to claim 39, wherein:

the calibration object has a reflective surface; and

the image data processing apparatus includes a texture generator operable to generate texture data for the three-dimensional computer model of the subject object in dependence upon image data that corresponds to reflections in the reflective surface.

48. A system according to claim 39, wherein the calibration object is three-dimensional.

49. A system according to claim 39, wherein the object support and the calibration object are formed as one with a surface for supporting the subject object such that, when the subject object sits thereon, the subject object is supported higher than, and separated from, the predetermined pattern of features.

50. Apparatus operable to process image data defining a plurality of images recorded at different positions and orientations of a subject object supported by an object support higher than a calibration object having a predetermined pattern of features, comprising:

a position and orientation calculator operable to process the image data to calculate the positions and orientations at which at least some of the images were recorded; and

a computer model generator operable to perform processing using the calculated positions and orientations to generate data defining a three-dimensional computer model of the subject object but not the object support.

51. Apparatus according to claim 50, wherein the position and orientation calculator includes a feature matcher operable to detect matching features in the image data defining respective images corresponding to features on the object support.

52. Apparatus according to claim 50, wherein:

the computer model generator includes an image data segmenter operable to process images to segment image data relating to at least the subject object from background image data; and

the computer model generator is operable to process the segmented image data and the calculated positions and orientations to generate the data defining the three-dimensional computer model.

53. Apparatus operable to process image data to generate a three-dimensional computer model, comprising:

an image data receiver for receiving image data

defining at least in part a plurality of images of a subject object supported by an object support recorded at different relative positions and orientations;

a position an orientation data receiver for receiving data defining the positions and orientations at which the images were recorded; and

a computer model generator operable to process the received data to generate data defining a three-dimensional computer model of the subject object but not the object support.

54. Apparatus according to claim 50 or claim 53, wherein the computer model generator is operable to perform processing using at least one known parameter of the object support to generate data defining the three-dimensional computer model of the subject object without generating data defining a three-dimensional computer model of the object support.

55. Apparatus according to claim 54, wherein the known parameter of the object support is the height of the object support.

56. Apparatus according to claim 55, wherein the computer model generator includes:

a voxel generator operable to define a volume of voxels in a three-dimensional space with the base plane of the volume set to be at a height higher than the calibration object corresponding to the known height of the object support; and

a voxel remover operable to remove voxels from the volume in dependence upon the image data.

57. Apparatus according to claim 50 or claim 53, wherein the computer model generator is operable to perform processing to generate at least one three-dimensional computer model of the subject object and object support and wherein the computer model generator includes a computer model remover operable to perform processing to remove the three-dimensional computer model of the object support.

58. Apparatus according to claim 57, wherein the computer model remover is operable to remove the three-dimensional computer model in dependence upon signals input by a user defining the three-dimensional computer model to be removed.

59. Apparatus according to claim 58, wherein the computer model remover includes:

an image data generator operable to generate image data for display to a user defining an image of the three-dimensional computer model of the subject object and object support, together with a plane moveable by the user; and

a user input signal receiver for receiving signals input by the user defining a position of the plane;

and wherein the computer model remover is operable to remove the three-dimensional computer model which lies on a predetermined side of the plane.

60. Apparatus according to claim 59, wherein the subject object is supported on the top-most surface of an object support standing on the calibration object, and the computer model remover is arranged to operate so that:

the plane is generated so as to have an orientation in a substantially horizontal plane; and

processing is performed to allow the user to move the position of the plane but not to change the orientation of the plane.

61. Apparatus according to claim 59, wherein the computer model remover is arranged to operate so that the plane is generated with the same shape and cross-sectional area as the object support.

62. Apparatus according to claim 59, wherein the computer model remover comprises:

a voxel definer operable to define a volume of voxels in a three-dimensional space such that a boundary of the volume is at a position corresponding to the position of the plane; and

a voxel remover operable to remove voxels from the volume in dependence upon the image data.

63. Apparatus according to claim 58, wherein:

the apparatus is arranged to carry out processing to generate a three-dimensional computer model of the subject object and a separate three-dimensional computer model of the object support;

the computer model remover includes:

an image data generator operable to generate image data for display to the user defining at least one image of the three-dimensional computer models; and

a user input signal receiver for receiving signals input by the user defining one of the three-dimensional computer models; and

the computer model remover is operable to remove one of the three-dimensional computer models in dependence upon the signals input by the user.

64. Apparatus according to claim 57, wherein the computer model remover is arranged to operate to identify the three-dimensional computer model to remove without signals input by a user.

65. Apparatus according to claim 64, wherein the apparatus is arranged to carry out processing to generate a three-dimensional computer model of the subject object and a separate three-dimensional computer model of the object support, and the computer model remover is arranged to carry out processing to remove the three-dimensional computer model having a position closest to the position corresponding to the position of the calibration object.

66. Apparatus according to claim 64, wherein the computer model remover is arranged to carry out processing to test at least one property of the three-dimensional computer model at different positions and to remove a part of the three-dimensional computer model in dependence upon a position at which the tested property changes.

67. Apparatus according to claim 66, wherein the computer model remover is arranged to test at least one

of the cross-sectional area and colour of the three-dimensional computer model to determine the part of the three-dimensional computer model to remove.

68. Apparatus according to claim 64, wherein the computer model remover comprises:

a data store for prestoring data defining a reference three-dimensional computer model of the object support;

a model comparer operable to compare the reference model against the three-dimensional computer model of the subject object and the object support to identify the part thereof which corresponds to the object support; and

a part remover operable to remove the identified part.

69. Apparatus according to claim 50 or claim 53, wherein the computer model generator includes a texture data generator operable to generate texture data using the image data.

70. Apparatus according to claim 69, wherein the texture data generator includes a reflection data identifier operable to process the image data to identify data corresponding to a reflection of the subject object in

a reflective surface, and wherein the texture data generator is operable to use the identified data to generate texture data for a surface of the three-dimensional computer model.

71. Apparatus according to claim 53, wherein the received image data comprises image data relating to the subject object and object support previously segmented from other image data in the recorded images.

72. Apparatus operable to process images of an object to generate data defining a three-dimensional computer model of the object and operable to amend the three-dimensional computer model, comprising:

an image data receiver for receiving image data defining at least in part a plurality of images of an object recorded at different positions and orientations;

a position and orientation data receiver for receiving data defining the positions and orientations at which the images were recorded;

a computer model generator operable to process the received data to generate data defining a three-dimensional computer model of the object;

a display data generator operable to generate data for display to a user defining an image of the three-

dimensional computer model together with a plane moveable by the user;

a user input signal receiver for receiving signals input by the user defining a position and orientation of the plane; and

a computer model processor operable to remove the part of the three-dimensional computer model which lies on one side of the plane.

73. Apparatus according to claim 72, wherein the computer model processor is operable to process received image data and received position and orientation data to generate data defining a three-dimensional computer model of the object in a three-dimensional space having a boundary defined by the plane.

74. A storage device storing instructions for causing a programmable processing apparatus to become operable to perform a method as set out in at least one of claims 13, 16 and 37.

75. A signal conveying instructions for causing a programmable processing apparatus to become operable to perform a method as set out in at least one of claims 13, 16 and 37.

76. A system for recording images of a subject object from different positions and orientations and for processing the recorded image data to generate a three-dimensional computer model of the subject object, comprising:

a calibration object having a predetermined pattern of features;

an object support for supporting the subject object higher than the calibration object;

an imager for recording, at different positions and orientations, a plurality of images of the subject object supported higher than the calibration object; and

an image data processing apparatus, comprising:

means for processing the recorded image data to calculate the position and orientation at which each of at least some of the images were recorded; and

means for performing processing using the calculated positions and orientations to generate data defining a three-dimensional computer model of at least the subject object.

77. Apparatus for processing image data defining a plurality of images recorded at different positions and orientations of a subject object supported by an object

support higher than a calibration object having a predetermined pattern of features, comprising:

means for processing the image data to calculate the positions and orientations at which at least some of the images were recorded, and

means for performing processing using the calculated positions and orientations to generate data defining a three-dimensional computer model of the subject object but not the object support.

78. Apparatus for processing image data to generate a three-dimensional computer model, comprising:

means for receiving image data defining at least in part a plurality of images of a subject object supported by an object support recorded at different relative positions and orientations;

means for receiving data defining the positions and orientations at which the images were recorded; and

means for processing the received data to generate data defining a three-dimensional computer model of the subject object but not the object support.

79. Apparatus for processing images of an object to generate data defining a three-dimensional computer model of the object and for amending the three-dimensional

computer model, comprising:

means for receiving image data defining at least in part a plurality of images of an object recorded at different positions and orientations;

means for receiving data defining the positions and orientations at which the images were recorded;

means for processing the received data to generate data defining a three-dimensional computer model of the object;

means for generating data for display to a user defining an image of the three-dimensional computer model together with a plane moveable by the user;

means for receiving signals input by the user defining a position and orientation of the plane; and

means for removing the part of the three-dimensional computer model which lies on one side of the plane.